SEP 1922

Subscription Price:
United States and Canada, $5.00 Per Year. Single Copies, 1 Shilling.
Foreign, $5.50 Per Year. Single Copies, 25 Cents.

VOLUME IV SEPTEMBER, 1922 NUMBER 5

THE JOURNAL OF INDUSTRIAL HYGIENE

AND ABSTRACT OF THE LITERATURE

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A Critical Age as a Factor in Labor Turnover

Poisoning by Benzol Carbon Tetrachloride Cement, with Special Reference to the Early Symptoms of Benzol Poisoning

Diagnosis and Supervision of Industrial Diseases in Germany

Industrial Diseases of Fur Cutters and Hatters

PUBLISHED MONTHLY BY HARVARD MEDICAL SCHOOL

EDITORIAL OFFICE : : : : 240 LONGWOOD AVENUE, BOSTON 17, MASSACHUSETTS
BUSINESS OFFICE : : : : 66 SEAVERNS AVENUE, BOSTON 30, MASSACHUSETTS

Entered as second-class matter, at the Post Office at Boston, Mass., under Act of March 3, 1879. Published Monthly.
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THE JOURNAL OF INDUSTRIAL HYGIENE

PUBLISHED MONTHLY

VOLUME IV SEPTEMBER, 1922 NUMBER 5

A CRITICAL AGE AS A FACTOR IN LABOR TURNOVER*

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AMONG the problems of industrial management, that of high labor turnover is one of the most perplexing. Efforts to reduce it usually begin with a tabulation of its causes under such headings as economic (low wages, unsatisfactory modes of payment, etc.); physical (dampness, dirt, etc.); social (uncongenial supervisors or fellow-workmen); and physiological (fatigue and occupational disease). Still other causes are sometimes recognized as psychological, though not so openly, partly because they are hidden from ready view, partly because the technic of industrial psychology, by means of which the causes must be investigated, is so meagerly developed. While investigating some of these psychological causes, the writer encountered one which furnishes data by means of which not only certain cases of labor turnover, but possibly many other phenomena of industrial life, may be interpreted. This cause is a critical age period in a worker's life, during which time he quits his job with especial readiness.

The figures upon which this conclusion is founded were drawn from the service records of 2,500 workmen who quit consecutively, either voluntarily or involuntarily (almost all resignations were, of course, voluntary), in four firms during 1920. Two of these groups (metal workers, 297 of whom were in firm C, and 294 in firm D) were investigated by the Scott Company, Philadelphia.[1] The other two groups (A, consisting of 1,483 workers who left the employ of a metal-trades manufactory; and B, consisting of the first 500 men leaving the service of a furniture factory during 1920) were investigated by the writer.

The workers were classified into age groups at five-year intervals, the age recorded being that given at the time of hiring. The average number of weeks worked by the members of each age group was then calculated. (See Table 1.) In case a worker had been hired, had resigned, and had been rehired, the length of service was computed for the

*Received for publication May 9, 1922.

[1] The kindness of the Scott Company for permission to use the data reported in their Bulletin L, 4, Oct. 25, 1920, is gratefully acknowledged, as is the courteous co-operation of Messrs. Earl Chamberlain and R. W. Marshall, employment managers, who furnished the writer with data, and of Lee Crawley and Claude Campbell who assisted in the laborious work of tabulation.

period immediately preceding each resignation.

Results and Conclusions

1. The curves in Figure 1 show, first of all, a relatively short period of service on the part of workers under 25 years of age. This is to be expected, in view of the natural instability of youthful interests, the entirely worthy search for vocational objective, and the absence of the anchorage of economic and social responsibilities.

2. The long service of workers over 50 is, of course, due to an opposite set of conditions: stability of interests, or habit, or recognition of the fact that gray hair is inimical to a favorable change of job.

3. With similar ease one can explain the long average period of service between the ages of 31 and 35, when men are rearing children and paying for a home.

4. Contrary to expectation, however, the length of service does not increase regularly with age. There comes a time when it decreases, namely, from 36 until 50 years of age, the minimum being reached between 41 and 50. In other words, this last-mentioned period appears to be a critical time when men give up their jobs with unusual frequency. This is manifest in the records of every one of these companies, although not so clearly in the case of company A as in the others. Indeed, the length of service for all ages is greater in this firm, probably because of the extraordinary measures which are taken to insure long service. By means of home visitation the company maintains oversight over living conditions and applies remedies even to the extent of helping a workman find a better house. In 1920 it gave a bonus to all who remained more than three months. (It will be noted that even the age groups with the shortest term of service remained, on the average, four months—just long enough to receive this bonus.) That such solicitude for the physical and mental conditions of workers served to prolong the term of service in this plant appears unmistakable, especially in the case of the men at the critical age period, but it could not completely obliterate the effect of this critical age, for instead of rising regularly to the 55-year period, the curve takes the shape of a plateau.

TABLE 1.—SHOWING NUMBER OF RESIGNATIONS AND AVERAGE NUMBER OF WEEKS SERVED IN DIFFERENT GROUPS.

Age	Number of Resignations		Average Number of Weeks	
	Co. A	Co. B	Co. A	Co. B
Under 21	271	204	18	10
21-25	341	96	19	9
26-30	296	60	23	11
31-35	231	30	31	24
36-40	155	38	28	19
41-45	84	26	29	12
46-50	72	17	30	8
51-55	17	12	58	15
Over 55	16	17	56	25
Totals	1,483	500		

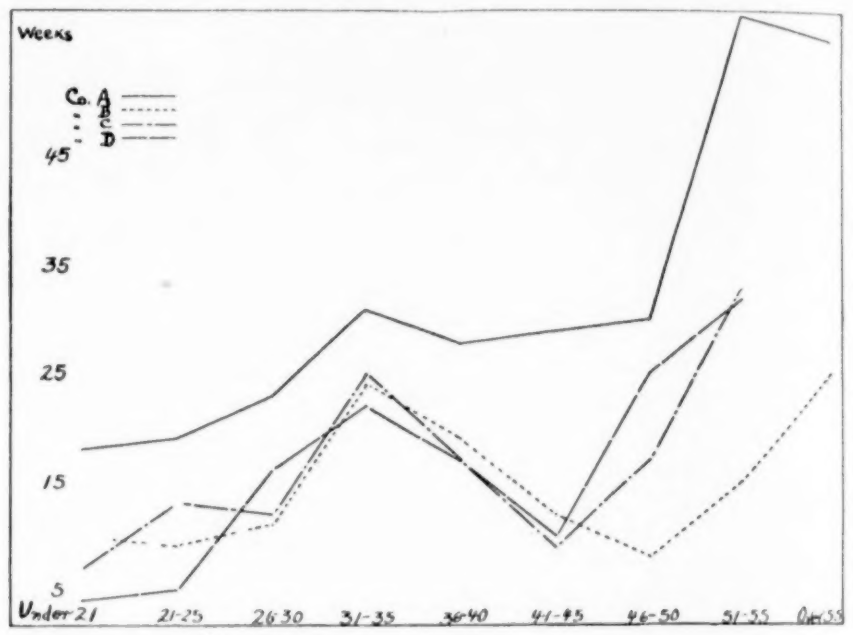

Fig. 1.—Showing average number of weeks worked by "quits" of various ages in four industrial establishments.

The explanation of this critical age phenomenon gives rise to several interesting hypotheses. The first two to be offered are economic; the third is psychophysical.

1. By the time he has reached the age of 40, the laboring man has usually reared his children to the point where they can at least partially provide for themselves, and he has perhaps completed the payments on his house; consequently, he feels a degree of freedom in leaving one job to seek another.

2. Again, as he nears 40, he realizes that he is entering upon the period of declining strength and graying hair, when it will be increasingly difficult to secure a new job. And if he sees no further possibilities in his present job he feels that now is the time to make a change.

3. Apart from these economic considerations, however, there are others of a psychophysical nature. At this period there may be generating within the man certain deep-seated physiological changes. Just as woman at approximately the age of 45 undergoes the period of change known as the menopause—a period characterized by glandular and organic adjustments and psychic disturbances more or less serious in character—so the male, as he reaches the same age probably passes through a similar period. Because the symptoms are not so highly marked in the male, the occurrence of the phenomenon is not so universally recognized even by the medical profession. Mendel (1), however, and Church (2) called attention to it about a dozen years ago, alleging that it lasts from eighteen months to three years, and manifests itself in the following symptoms: high arterial tension, digestive and intestinal disorders, headaches, quick fatigue, oppressed feelings in the chest, sudden sensations of an alarming nature, especially vertigo. Most striking of all are the psychic accompaniments of the period: an almost invariable tendency to mental instability, sometimes leading to actual insanity, sometimes consisting merely of what Freud calls an "anxiety neurosis" (directed, perhaps, to the period of impotence which is due in ten or twenty years?).

It is interesting to note in this connection that the age at which persons coming down with senile dementia begin to come to state hospitals for mental diseases is between 40 and 49, and that patients suffering from general paralysis are admitted in greatest number between the ages of 40 and 49 (3).

We may reasonably believe, therefore, that there is a period in a man's life when he becomes especially unsettled mentally, and that this uneasiness expresses itself in the special frequency with which the men included in the investigation here reported quit their jobs.

Such a conclusion suggests that employers should exert considerable solicitude for men at this critical age; that they should be on the watch for symptoms of restlessness and irritability; that they should view these symptoms with toleration and sympathetic understanding; and that they should endeavor to take special remedial measures, such as giving increased responsibility, or more pay, or even a change of job, to those who are worthy. It suggests further that just as this critical age period affects the tendency of a man to quit his job, so may it affect him in other industrial relationships; even in other non-industrial respects, all of which should be investigated. The problem should be studied also in connection with workers in various classes of occupations.

Finally, the demonstration that such

obscure influences can be expressed quantitatively suggests that there may be others that can be demonstrated in the same way. Interesting speculations are advanced by economists who are desirous of bending the Freudian hypothesis to the ends of economic theorizing, to the effect that suppressed psychic forces operate to direct human beings at work. But before any hypotheses can be accepted, they must be subjected to the laborious investigation and quantification that have marked this demonstration of the relation between the critical age and labor turnover.

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POISONING BY BENZOL CARBON TETRACHLORIDE CEMENT, WITH SPECIAL REFERENCE TO THE EARLY SYMPTOMS OF BENZOL POISONING*

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THE freedom from fire risk attached to the combination of carbon tetrachloride with benzol appears to add to the industrial uses of the latter substance. The solvent properties of carbon tetrachloride and its cheapness likewise make of it a useful adjuvant when combined with benzol. Six months ago my attention was directed to some unfavorable effects resulting from a quickly drying, non-inflammable rubber cement in which this combination was found. Although the cement in question is said to have been on the market for a number of years, I have been unable to find in the literature, after a fairly careful search, any reference to the potential dangers associated with its use.

Injury to health from the use of the solvent, benzol, has been long recognized, especially on the continent of Europe, and was first reported in this country about twelve years ago (1). Numerous reports regarding the poisonous properties of benzol have since appeared in our literature. These have all been fully summarized in a recent article by Dr. Alice Hamilton (2). With only one possible exception, none of the American authors has dwelt upon the early symptoms of benzol poisoning. Nearly all the reports relate to cases that were either fatal or nearly so. It is believed that a more general acquaintance should be had with the early, less drastic symptoms of benzol poisoning, as they are hereafter set forth, especially in view of the importance of recognizing early symptoms in connection with preventive measures. After advanced symptoms have appeared much damage has been done and valuable time has been lost.

A brief review of the effects produced by carbon tetrachloride also seems justifiable because of its use in the cement in question and in view of the scattered literature on the subject, although it is not thought to have been a conspicuous factor in the cases reported in this article.

The cement referred to is manufactured for use in millinery establishments and thousands of cans are said to be sold throughout the United States and Canada. There is reason to believe that cement of this type has quite generally supplanted the needle and thread in some phases of hat making in the millinery industry. Economy in production now practically requires its use in certain processes. Hubbard and Kefauver (3), in 1920, published a rather complete report of conditions affecting health in the millinery industry. Benzol is mentioned, briefly only, among other poison hazards, but carbon tetrachloride is not included.

A Recent Factory Experience

In October, 1921, a case diagnosed as benzol poisoning was brought to the no-

*Received for publication May 22, 1922.

†Deceased June 21, 1922.

tice of our department. The illness affected a young woman employed as a hat maker in a wholesale millinery establishment. The symptoms described were severe gastralgia, irritation of the upper respiratory mucous membrane, headache, and tachycardia. About twenty girls were reported to be similarly affected. The following is a digest of the first-hand inquiry which was at once made.

The millinery establishment was housed in a long five-story building. Each end of the second floor and a portion of the fifth floor were partitioned off and equipped with tables, around each of which five or six girls were seated, engaged mostly in hat making. Open cans of cement were kept on the tables. Each girl reached forward, dipped a long-handled brush into a cement can, and then pasted cement on a buckram hat form held in her lap, while she pressed the cloth or other material into place. Until about eight years ago, these materials were always sewed into place. Facilities for natural ventilation were not the best and artificial means were not provided. The odor of benzol was quite distinct even at a distance from the partitioned rooms. The company officials stated that they had been using this brand of cement for about four years but had never before had any trouble with it.

The chief trouble arose coincident with the closing of the windows at the onset of cool weather. It was suggested that some change had been made in the formula of the last batch of cement purchased from the manufacturer. In answer to a letter of complaint, however, the manufacturer denied any change in the formula, but admitted that three other complaints had been made in the past regarding fumes from the cement. These disagreeable experiences were all ascribed by the manufacturer to faulty ventilation of the workplace and to physical ailments having no connection with the use of cement. In our chemist's analysis of the cement, sample A was taken from a can about half used, sample B from a new can freshly opened. The results were as follows:

	Sample A	Sample B
	%	%
Residue on evaporation, largely rubber.....	3.60	3.11
Solvent:		
Carbon tetrachloride (CCl_4)	70.0[1]	66.0[1]
Benzine (benzol) (C_6H_6)	30.0[1]	34.0[1]
Carbon bisulphide (CS_2)	– –	0.05

[1]Per cent by volume.

Of the forty girls employed (all of whom were native white Americans), thirty-one were engaged in processes involving more or less exposure to cement fumes. Chief among these processes was one known as hat making, or securing cloth coverings and trimmings to buckram shapes by means of a quickly drying cement. Of the thirty-one girls more or less exposed, four, who were engaged in designing, machine operating, and cutting, did not handle cement. Two of these were, however, somewhat affected by the fumes. Twenty-two of the twenty-seven who handled cement had definite symptoms, the other five complained of no symptoms. All of the thirty-one girls were individually questioned in a quiet room secured for consultation through the courtesy of the managers who co-operated with the investigators in every way. The following brief case reports are presented as representative of the symptoms recited.

Case 1.—Miss ——, aged 21, a woman of rather delicate appearance, had worked as a hat maker in this establishment for about four months. She had had no noteworthy symptoms of poisoning until about three weeks previous to the investigation, but since then she had had attacks of nausea, accompanied by sensations of giddiness and faintness, on

account of which, one day, she could hardly reach her home. She complained of frequent urination and headache. She had used cloth masks over her mouth and nose when working with the cement, but had found them ineffectual. She gave no history of hemorrhages. She attributed the symptoms to the cement.

CASE 2.—Miss ——, aged 21, a woman of rather delicate appearance, had worked in the establishment as a hat maker and trimmer about fourteen months. About three weeks before the inquiry she became nauseated and very dizzy while at work. About ten days later at 4 o'clock in the afternoon she became dizzy and sick, and upon going home stayed in bed for twenty-four hours before she recovered. She was exceedingly weak and dizzy, and "could hardly get her breath." She claimed that she had never had such symptoms before, and that she always felt worse when she used much cement. She gave no history of hemorrhages or of "blue spots" on the body.

CASE 3.— Miss ——, aged 27, a maker, had worked in the establishment for sixteen months. A year previous to the inquiry her eyes had troubled her and she had been obliged to be fitted to glasses. A little more than two weeks before the investigation she became nauseated and her throat and stomach burned. Other symptoms were frequent urination, severe headache, and dizziness. Nearly every night she became worse after boarding the street car to go home, and during the evening nausea, giddiness, and weakness increased. She usually felt much better in the morning until she had worked for a short time. When further questioned on November 21, she stated that one evening about a month before, during an attack of nausea attributed to cement fumes, she had vomited about two teaspoonfuls of blood. This had never occurred before. She had had no stomach symptoms until a few weeks before this investigation. She claimed that she had noticed distinct bruise-like spots on her right thigh for which she could not account.

CASE 4.—Miss ——, aged 19, a maker, had used cement ever since entering the company's employment fifteen months before. She had noticed no symptoms until about three weeks before this inquiry, when she could keep no food on her stomach except toast and eggs. She suffered from giddiness and weakness, which she attributed to the cement. Just before leaving her work at night she always felt badly, and upon arrival at home she felt worse and often vomited. She said that her eyes and throat had burned a great deal in the previous three weeks, especially after she had opened a can of cement. She did not complain of frequent urination and had had no hemorrhages.

CASE 5.—Miss ——, aged 23, a maker, apparently strong and healthy, had worked in the establishment for seven years, and had previously been employed at the same work. She stated that three weeks before the investigation she became nauseated and vomited while at work and in the evening at home. She always felt worse in the evening. One evening, two weeks after the first attack she became very ill on the way home, and that night vomited repeatedly until 12 o'clock. The vomit contained no blood, however. Her throat, chest, and stomach burned a great deal. She had noticed no effect on urination. Following this occurrence she was very weak and did no work for five days. The girl said that one of the other employees who had died about two weeks before had complained of similar symptoms caused by the cement.

CASE 6.—Mrs.——, aged 42, who had been employed as a cutter for two years, had used a good deal of cement in pasting during the previous two months only. She often used it for two hours at a time, pasting as many as twenty hats in succession. She claimed that since she had worked with the cement she had been exhausted upon her arrival at home, that her throat felt sore and burned, and that her chest also felt sore. She complained of frequent urination when she used cement, and of dizzy spells. With cessation of the use of cement, she felt much better. She gave no history of hemorrhages or of "bruises" on the body.

CASE 7.—Miss ——, aged 37, a healthy appearing woman, had been employed with this company as a maker and trimmer for two years. Previously she had worked at the same employment in a retail establishment where less cement was used. She said that she always felt nauseated when the ventilation was poor. For three weeks she had had a burning sensation from "her tongue all the way down to her stomach." She had lost a half-day two weeks before and an entire day a week later "on account of cement." Of late she had been unable to eat tomatoes or anything acid. Eating seemed to hurt her stomach. She tasted cement after getting out into the air, and during the evening. At night she urinated frequently.

CASE 8.—Miss ——, aged 54, had been employed as a maker and trimmer for twenty years and had worked for this company for five years. She said that, although she had used cement for eight years, she had never noticed any ill effects from it until three weeks before. Since this time she had been

miserable with nausea and a burning sensation in the stomach. Her eyes burned and her heart action seemed to be affected; she also complained of a sense of faintness and weakness, and frequent urination.

CASE 9.—Miss ——, aged 37, a second-floor maker, had worked in this establishment for ten months and had had no ill effects until a short time before the inquiry. She had just returned from a week's absence on account of sickness which she attributed to cement, and had been ill for a week previously. Her symptoms were nausea and vomiting, gas on the stomach and bowels, and very sore bowels. Dizziness and weakness were more pronounced after she left the factory at night. She also complained that she had difficulty in breathing, that her chest was sore, and that her lips and throat burned. Before leaving work she had suffered from an itching inflammation on the ulnar surface of both forearms. This improved, however, while she was away from work, but recurred after she resumed work. She had always been strong, and looked well.

CASE 10.—Miss ——, aged 30, a maker, had worked for this company for eight months. The week previous to this investigation she had been severely nauseated. She had often felt so sick upon arriving at home that she had been obliged to retire immediately without eating her supper. Her forearms were superficially inflamed and her finger tips sore. The patient attributed all these symptoms to the cement.

The rather hasty physical examination of these cases necessitated by the circumstances gave practically negative results. Pulse and heart action at the time of examination were not disturbed. Mucous membranes in some cases were quite pale, in others normal. A conspicuous symptom was the burning sensation in the epigastrium, with tenderness on pressure. The blue spots on the thigh of Case 3 had disappeared at the time of a second examination (one month later). No disturbance of the menstrual function was elicited. Circumstances were not favorable for collecting blood samples. Except for the presence of cement no condition common to all the employees affected could be found to account for the symptoms. Inquiry into the death referred to by Case 5 indicated that death was due to a perforated gastric ulcer. There had been no confirmatory operative or postmortem findings. Moreover, the physician in charge of the case had not elicited the fact that the patient's illness was primarily associated with the breathing of cement fumes. In this connection it is perhaps significant that Sury-Bienz (4), Beinhauer (5), and others have found hemorrhages into the gastric mucosa in poisoning by benzol, and that Weiskotten and his collaborators (6), in careful experiments upon animals poisoned by benzol under conditions similar to those found in industry, found hemorrhages into the gastro-intestinal mucosa in three animals, and in one, small ulcers in the gastric mucosa.

While the author is of the opinion, after careful consideration, that the symptoms complained of by these patients were chiefly due to benzol, it would be inadvisable thus to dispose of the question of carbon tetrachloride without some reference to its systemic effects.

CARBON TETRACHLORIDE

Carbon tetrachloride came into general industrial use a number of years ago, partly as a result of improvements in its manufacture on a large scale, and partly because of its non-inflammability and its less toxic properties as compared with other solvents (carbon bisulphide, benzine, etc.). It is a heavy, colorless liquid, having an aromatic odor and a boiling point of 76.7°C. It is readily vaporized into a colorless vapor 5.33 times heavier than air. This property, together with its non-inflammability, makes it a most valuable agent in shutting out air from surfaces blanketed by it, and thus renders it useful in extinguishing fires.

Carbon tetrachloride first claimed the attention of the medical profession in December, 1865, when J. Y. Simpson (7) of Edinburgh suggested its use as a general anesthetic. Its alleged heart depressant properties, however, soon led to its abandonment. It was used as an agent for shampooing the hair in the early part of this century, but Colman (8) warned against its use, claiming that it was dangerous to life. Its action is similar to that of chloroform, though more depressant to circulation and respiration. In a footnote by Marshall to Colman's article, reference is made to the use of carbon tetrachloride in the sixties as an agent for the relief of headache, neuralgia, chorea, etc. Its ill effects caused it to be discontinued. There is recorded a case in which death took place very suddenly during the application of carbon tetrachloride in a dry shampoo (9). The presence of status lymphaticus in this case is said to have occasioned some doubt as to the true cause of death. Waller and Veley (10) concluded, from experimental studies, that carbon tetrachloride was considerably more toxic than chloroform. Rambousek (11) states that "carbon tetrachloride, so far as its poisonous qualities are concerned, is to be preferred to other extractives" such as carbon bisulphide, benzine, etc. "The narcotic effect is only half that of chloroform; it causes, however, a more violent excitation; inhaling the fumes brings on nausea, coughing, sickness, headache, etc."

Allison and Katz (12) found that the least concentration in the air of carbon tetrachloride, detectable by the olfactory sense, was 718 parts per million, and that when concentrated to the extent of 6,091 parts per million, the odor was "very strong." The authors point out that the soporific effect of carbon tetrachloride may account for the high concentration required before the odor is clearly detectable.

Lewin (13), discussing the effects of carbon tetrachloride, states that it is about twice as poisonous as chloroform; that, when a person inhales it, his breathing first becomes heavy, then he becomes delirious, is unable to stand, is nauseated and blue, and has dilated pupils. There is headache upon recovery.

Fieldner, Katz, and Kinney (14), in a recent bulletin of the Bureau of Mines, discuss the dangers associated with the use of carbon tetrachloride in fire extinguishers in confined places and upon heated surfaces. These dangers relate more particularly to the decomposition products of carbon tetrachloride (chlorine, phosgene, and hydrochloric acid gas). "Comparatively large amounts of carbon tetrachloride vapor must be breathed before the effects become dangerous." These authors quote Lehmann to the effect that "3,980 parts per million (about 0.4 per cent.) may be inhaled for about an hour without very serious effects."

Hall (15) directs attention to the utility of carbon tetrachloride as an anthelmintic when given by mouth in hard gelatin capsules for the removal of hookworms. He concludes that it is safer than other drugs used for this purpose, and indicates that the dangers ascribed to its inhalation have been overrated, a fact which "is perhaps responsible for the neglect of this drug for half a century."

Carbon bisulphide may be present in carbon tetrachloride as a residue resulting from the process of manufacture. It was not found in one of the samples of cement examined by us; it was present in the other, but not in an amount dangerous to health.

In considering the toxic properties of carbon tetrachloride a distinction must be made between its use as an anesthetic and its use as an industrial agent. Apparently fairly large amounts of the vapor must be breathed before toxic symptoms are produced. In none of the cases studied were the soporific effects ascribed to carbon tetrachloride noticeable. The weight of the vapor is such that, in the absence of any especial air movement, such as in the place under discussion, it would have a greater tendency than benzol to fall from its source toward the floor and away from the breathing level. The vapors of both agents, however, are quite diffusible, particularly benzol vapor. In utilizing carbon tetrachloride as a delousing agent, Foster (16) took advantage of the tendency of the vapor to fall to the bottom of a tall can in which infested clothing was placed. In the case of alleged death from carbon tetrachloride used for shampooing the hair, the conditions were most favorable for toxic effects as remarked by Marshall, the vapor naturally falling from above the breathing level directly over the face. This is a situation which could scarcely be imitated in ordinary industrial processes, and yet thousands of people are said to have had their heads shampooed with carbon tetrachloride without ill effects except in a few cases in which fainting took place (8).

By way of summarizing, it may be said that the danger of poisoning by carbon tetrachloride as used in the cement in question seems rather remote, though it may have contributed somewhat to the complex of symptoms.

Benzol

About two years ago Newton (17) described the case of a chemist, aged 30, who had been working two weeks with benzol, when he complained of headache, lassitude, loss of weight, pain in the abdomen, nausea, and vomiting. A physical examination proved negative. An examination of the blood, however, revealed a marked leukopenia. Two other chemists similarly exposed were without symptoms, but both had a marked leukopenia. Apparently this is the first case in the United States in which early subjective symptoms of benzol poisoning are described. No mention is made of irritation of the mucous membrane, or of bladder irritability (evidenced by frequent urination), as found in a number of the cases here presented. Lehmann, as quoted by Hamilton (2), found, in experimenting with cats, a decided variation of susceptibility to benzol in individuals, but, in all, signs of irritation of mucous membranes were present. Rambousek states that the fumes of benzol exercise a distinctly irritant effect upon the mucous membrane.

No mention of bladder irritability is found in the literature, as associated with poisoning either by benzol or by carbon tetrachloride. Jaffé (18) found muconic acid in the urine of dogs and rabbits which had been fed for some time with benzol. Brewer and Weiskotten (19) observe that it has long been known that benzol, when taken into the body, is oxidized at least in part to phenols by the body tissues, and that an appreciable amount of these phenols is excreted in the urine. Whether the elimination of these agents in the urine could account for the bladder irritability observed in a number of these cases is uncertain.

Early Diagnosis.—While the laboratory findings of Newton and his predecessors would give the impression that the leukocyte count is a dependable means of early diagnosis of industrial

benzol poisoning, the evidence is not yet conclusive on this point. Hektoen's experiments (20) indicate that there are certain exceptions to the rule, as far as leukopenia is concerned. At least, in benzenized rabbits leukopenia is not always produced, and in dogs reduction takes place only after hemorrhages and fatty changes have occurred. At the height of antibody production, benzol appears to have but little effect on the leukocytes in the circulating blood. Furthermore, were the procedure entirely reliable, there are many millinery establishments as well as other industrial concerns which are too small to afford the expense of repeated laboratory tests for the discovery of early evidences of benzol toxemia.

According to Thomas M. Legge (21), Burnet (Certifying Surgeon for Edinburgh East) regards hemorrhages from the mucous membranes of the gums and nose as an early symptom of benzol poisoning and one that can be safely used as a guide for the purpose of exclusion from work. Though hemorrhage from the nose and mouth may be accepted as a danger signal in benzol poisoning, the question may be raised as to the advisability of the general adoption of this sign as a sufficiently early signal for exclusion from work. Can we be certain, for instance, in any given case, that earlier hemorrhage has not been concealed in some internal organ before its external manifestation? If one may draw any conclusions from the cases here presented, in which but one patient showed any evidence of hemorrhage, it appears that well-defined symptoms are produced by benzol long before hemorrhage of the nose and mouth is produced, or before any evidences of subcutaneous capillary leakage (purpura) appear. These early symptoms should receive more attention.

It is true that in these cases most of the symptoms are subjective in character, but in dealing with an agent as poisonous as benzol some notice should certainly be taken of a set of concurrent subjective symptoms as similar as were those here described, in persons working under the same conditions. Moreover, the recognition of the early symptoms of disease is a most important factor in prevention. It is essential, therefore, that employers, safety men, and physicians should have a more general acquaintance with the early symptoms of benzol poisoning, so that preventive measures may be taken before serious damage is done.

While benzol was manufactured in the United States for many years before the war, chiefly by the Barrett Company, the relative cheapness of petroleum benzine greatly restricted its use. The demand during the war for the manufacture of American explosives and dyes stimulated the production of benzol and its homologues. The armistice, as Dr. Hamilton states, left the producers with the problem of finding new markets for their products. That the new markets have been found is shown by the expenditure of millions of dollars by the steel plants in the installation of by-product coke ovens, from which our chief supply of benzol is derived. Although benzol is now more expensive than it was before the war, the petroleum product, benzine, judging from market quotations, has so greatly increased in price that benzol can be purchased at least as cheaply as benzine. The great superiority of benzol over benzine for many industrial purposes further accounts for the present popularity of benzol.

In their report on industrial poisons, prepared at the request of the committee of the International Association for

Labor Legislation, Sommerfeld and Fischer (22) point out that female workers, particularly in their developmental years and especially at the time of menstruation, are more susceptible to benzol poisoning than are men, and are susceptible in an extraordinary degree to the subacute and chronic forms. The authors advise the exclusion of women from every employment in which benzol is used. Women are, nevertheless, increasingly exposed to benzol in American industry. To attempt to prohibit its use on account of the effect on some individuals seems to be out of the question. Efforts might better be directed toward educating employers and others responsible for factory conditions to the importance of adequate general ventilation of workrooms where benzol is used, and to the early symptoms of poisoning by it. Great caution should be observed in using it in closely confined quarters. Its utility in millinery cement depends largely upon its rapid and complete vaporization. It is probable that local exhaust ventilation is not so feasible as dilution by adequate, general forced ventilation, the air being exhausted from workrooms preferably through openings or gratings in the floor. The production of toxic symptoms in laboratory animals (rabbits, dogs, and cats) exposed to benzol fumes in concentrations of 2.4 to 5.7 parts per 100,000 of air (Rambousek), as well as observations on man, suggests the advisability of not permitting benzol fumes to accumulate in workrooms to an extent greater than 1 part per 100,000 of air.

Instructions regarding ventilation should be printed on the label of every container holding benzol in any quantity which might, under unfavorable conditions, cause symptoms. The manufacturer of the cement in question has kindly agreed to place such instructions on all labels printed in the future.

Many brands of cement are on the market. Besides millinery cement, there are cements designed to secure rubber to rubber, leather to leather, and rubber to leather, and there are numerous fabric cements. It is probable that most of the superior ones depend upon the solvent action of benzol and its rapid vaporization when once applied. Careful analysis of one sample yielded benzol forming 49.5 per cent. by volume of the total solvent, and analysis of another, 76 per cent. One sample claimed by the agent to be of inferior quality contained no benzol, the solvent consisting entirely of petroleum ether (high test gasoline). Still another brand contained only 8 per cent. of benzol, the remainder of the solvent—92 per cent.—consisting of the poisonous solvent, carbon bisulphide.

It is doubtful whether the occasional use of benzol cements is injurious to health, but when their use becomes more or less continuous, especially in confined quarters and with the absence of abundant ventilation, toxic symptoms may be expected, and should be recognized before advanced tissue changes develop.

Summary

My objects in presenting this article are:

1. To direct attention to the importance of such early and relatively mild symptoms of benzol intoxication as irritation of the mucous membrane of the upper respiratory tract, nausea, vomiting, burning sensation in the epigastrium, frequent urination, giddiness, slight air hunger, and weakness. These symptoms have a tendency to grow worse after an affected person leaves the atmosphere of the factory.

2. To point out the bearing on industrial health of the increased use of ben-

zol afforded by its combination with carbon tetrachloride in a non-inflammable mixture.

3. To direct attention to the importance of safeguards for the protection of employees, especially women, who handle benzol.

4. To urge the advisability of printing in conspicuous type on the label of every container holding benzol a caution concerning the importance of adequate ventilation in places where benzol is used.

5. To assemble a fairly complete bibliography on the systemic effects of carbon tetrachloride.

On account of the rapidity with which benzol vaporizes and the difficulty of confining its application to a small area, at least in the millinery industry, efficient exhaust ventilation should be carefully studied. It is probable that local exhaust ventilation is not so feasible or reliable in many processes as dilution by means of forced general ventilation, the air being removed from the workroom in a downward direction through floor gratings.

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DIAGNOSIS AND SUPERVISION OF INDUSTRIAL DISEASES IN GERMANY*

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AT the cradle of every modern movement for industrial hygiene have stood physicians. In England in 1796 Dr. Percival called attention to the fearful consequences of child labor and gave impetus to the first English child labor laws. Likewise in Prussia thirty years later, it was the reports of the military surgeons on the decline in military fitness of the inhabitants of the Rhenish industrial districts, which led to the first Prussian child labor laws (1839). For the administration of these laws local police, teachers, and clergy were responsible. Not until the law of 1853 was provision made that, when necessary, supervision should be carried out by factory inspectors. In England similar laws led to the extensive cooperation of physicians in industrial supervision, inasmuch as the apparent age of the children could be legally established only by a medical certificate. In Prussia and Germany, where the Civil Registry was already highly organized, proof of age followed upon presentation of certificates of birth and baptism.

Although the earliest instructions for factory inspectors emphasized the necessity for hygienic supervision of workrooms, nevertheless the control of child labor (which alone was regulated by law) was entirely a police measure, particularly as the first factory inspectors were minor police officials. As technical science advanced, accident prevention assumed the more important place, and as a result technical men were, for the most part, appointed inspectors. The present Prussian regulations regarding the training of factory inspectors (dating from 1891) require that all applicants pass a state examination as engineer or chemist. This requirement naturally excludes physicians from inspection of factories. The local health official, the district physician, has not the right to make factory visits on his own authority, but must communicate with the factory inspection officials. In the sanctioning of new factory projects he is obliged to assist in the examination of the specifications, but he can visit the proposed site for this purpose only on official invitation. At the same time he is so burdened with other official duties that his activity in the field of industrial hygiene must be extremely limited. This explains the fact that while factory construction and accident prevention have made enormous progress in Germany, thanks to the tireless efforts of technical inspectors, and particularly in the Rheinlands have reached a height which is not equaled in Austria, Belgium or Italy, and which, so far as I can deduce from the literature, is not surpassed in any other country, nevertheless, industrial diseases have not received the consideration which unfortunately they demand.

It is in the supervision of occupations which are hazardous to health that physicians can least of all be dispensed with; their services have always been required, although hitherto to an

*Translated by Dr. John W. S. Brady, Harvard Medical School. Received for publication March 8, 1922.

insufficient degree. As long ago as 1847 the Middle Frankish Government (Bavaria) requested the municipal council of Fürth, the center of the mercury mirror industry, to co-operate with the government physician and the factory owners in establishing protective measures against the harmful action of mercury on the health of the workers. This resulted in the issuing of an order by the municipal council, in 1853, that no one without an official medical certificate should be accepted as a worker in a mirror quicksilvering establishment; in addition, the government ordered that the workers in these plants should be given a medical examination every three months, and that health instruction should be provided by government physicians. In 1858 employers were made responsible for the keeping of an accurate record of workers entering and leaving their employ. A move in a somewhat different direction was the ordinance of 1877 issued by the chief of police on the occasion of the establishment of a mirror silvering factory in Berlin. This ordinance required that the factory owner refer his workmen to a definite physician for regular care and continuous observation, and that sickness records be kept.

Thus were laid the foundations for medical supervision which, in the following years, was prescribed for a number of occupations hazardous to health (match factories in Prussia, May 13, 1884; lead paint and lead acetate factories in Prussia, April 12, 1886; and mirror factories in Prussia and Bavaria in 1889). In these trades the employment of workers is permitted only on the presentation of a medical certificate of health. Moreover, the employer is required (1) to entrust the supervision of the health of his employees to a physician, whose name is to be sent to the industrial supervision officers and who at regular prescribed intervals shall inspect the employees; and (2) to keep a record of men entering and leaving his employ, of sickness, and the results of the periodic examination of every workman.

The unsatisfactory aspect of these regulations lies in the fact that it is a physician engaged by the employer to whom the supervision of the workers' health and, indirectly, the hygienic condition of the manufacturing processes are entrusted. Dismissal of workmen from the factory and significant entries in regard to unfavorable health conditions attract the attention of the government industrial inspectors; and this results in further hygienic regulation. It is thus easy to understand why many an employer prefers a physician who notices little that is unfavorable, and who makes his examinations and entries perfunctorily, merely to satisfy the legal requirements; and why, on the other hand, a conscientious physician sometimes makes himself unpopular with his employer.

In order to assure government authorities a certain influence over the employment of the examining physician, later legislation (first in 1905 in a regulation regarding lead smelters) required that the examination be entrusted by the employer to a physician authorized for that purpose by the government, whose name must be reported to the government industrial supervision officers. In the latest law (relating to lead color works, January 27, 1920) a further step has been taken: "Authorization is granted only when the physician has obligated himself to carry out the instructions prepared by the Ministry of Labor," and "if the employer wishes to discharge a physician entrusted with

the supervision of his employees' health, he must first file a notice with the state authorities giving his reasons." This seems a further step toward making the examining physician somewhat more independent of his employer; and it is to be hoped that the work will soon be carried on by physicians who are entirely independent.

Medical supervision of employees (in addition to physical examinations on entry) is at the present time prescribed for the following industries:

Lead smelters, at least once a month (law of June 16, 1905).

Zinc smelters and zinc roasting furnaces, at least once a month (December 13, 1912).

Storage battery plants, at least once a month (May 16, 1908).

Manufacture of alkaline chromates, at least once a month (May 16, 1907).

Nitro and amido compounds, preparation or recovery, at least once a month (1911).

Thomas slag, at least once a month (July 3, 1909, and December 23, 1911).

Preparation of lead colors and other lead compounds, at least twice a month (January 27, 1920).

Painters and paint workers in connection with other industrial processes, at least every half year (June 27, 1905).

Vulcanizing of rubber goods, at least once a month (March 1, 1902).

There has been a further step in another direction in requiring medical co-operation. In certain factories, before the admission of young persons—at least to certain processes—medical opinion as to their fitness for the work is required. Here, too, it is a physician engaged by the employer who decides whether young persons shall be allowed to engage in the work, and, if so, which applicants are fitted for employment. Medical examination before employment in factories or in particular processes is prescribed as follows:

For girls of 16 to 18 years of age before employment in collieries, zinc and lead ore works, and coke works in the Oppeln district (under certain conditions). (Decrees of March 24, 1892, March 20, 1902, and April 12, 1907.)

For young male applicants for work in collieries (under certain conditions). (March 7, 1913.)

For young male applicants for work in rolling mills and forges (under certain conditions). (May 20, 1912.)

For young male applicants for work in certain processes in glass furnaces, glass polishing and glass etching plants. (March 9, 1913.)

It should here be stated that the great chemical establishments of Germany have installed in their plants physicians who, having the opportunity to study the diseases occurring in that industry, have thereby acquired an intimate acquaintance with the rarer forms of industrial disease, and have enriched the German literature on the subject through numerous valuable contributions.

The industrial supervision officers frequently publish information about the prevailing industrial diseases, based on the above-mentioned records. As far as one can generalize from particular cases, however, the figures given must be lower than the actual number. Take for example an investigation by the district physician at Kattowitz, in 1909, into the physical condition of workers in zinc smelters. He examined the working personnel of smelters where no cases of sickness had been reported for several years, and found symptoms of lead poisoning in 20.5 per cent. of the workers examined. Through questions he was able to elicit little specific information about earlier sickness, as

the workers interviewed were apparently fearful that if they gave too detailed answers they might lose their positions, and consequently were reluctant to answer.

For many years the figures of the industrial inspectors have been based on the cases reported to them by the sickness insurance offices. Sickness insurance for workmen has been compulsory in Germany since 1884. The changes effected in the sickness insurance law by the State Insurance Law make it obligatory for the presidents of sickness insurance offices to furnish the industrial supervisors, on request, information in regard to the number and character of the diseases which they have recorded. Although this law did not go into effect until January 1, 1914, as early as 1912 the Prussian industrial supervisors, on the basis of a ministerial decree, applied to the sickness insurance offices for information, and requested the reporting of cases of poisoning by lead, mercury, arsenic, and phosphorus. Bavaria went further and required the reporting of a number of other poisons. It is, however, generally acknowledged that the notifications are incompletely made and that they contain a large number of errors in diagnosis. Consequently, we must accept the figures from these sources with a great deal of hesitancy.

At this point some data for the year 1912 will be given since conditions were considerably changed during the war as a result of various circumstances—namely, the lack of lead compounds, the greater preoccupation of physicians with other tasks, the absence on military duty of a number of factory inspectors, and the imposition on the others of tasks made necessary by war conditions. According to the latest reports which are available, conditions have not yet returned to normal. In 1913, however, the reports contained but few data on industrial poisoning because an unusually full report on the subject was made in 1912. The Bavarian district industrial physician — whose services I shall mention later—sent out a questionnaire to the various hospitals in Bavaria for the purpose of securing a report of cases of industrial poisoning. The replies reported 126 cases of lead poisoning in painters, 1 case of mercury poisoning, 9 cases of arsenic poisoning, 238 cases of eczema, and 375 cases with symptoms of fatigue or exhaustion (deformities, tenosynovitis). In the last four months of the year, since the introduction of compulsory reporting, the Bavarian sickness insurance offices reported 170 cases of lead poisoning, 4 of poisoning with benzine, benzol, and carbon disulphide, and 16 cases of poisoning with nitro and amido compounds. In the Potsdam district (Prussia), 138 cases of lead poisoning were reported to the industrial supervisors. Fifty-five cases of lead colic and paralysis were reported among the zinc-smelter workers of the Oppeln district, and 33 cases among lead-smelter workers. In the lead industries of the Wiesbaden district there were 153 cases of poisoning, of which 108 occurred in smelters; in the Düsseldorf district 3 cases were reported among a total of 644 zinc-smelter workers, and 8 cases among a total of 648 lead workers. Among 763 workers, the average number employed during the year in the lead paint factories of the Cologne district, 126 cases of sickness due to lead occurred. From Saxony 148 cases of lead poisoning were reported. I have selected only a few figures from the reports; further enumeration would be tiresome as would also accounts of individual cases of poisoning with sub-

stances other than lead. Francke[1] states that in the short fraction of the year 1912 for which the sickness insurance offices made their returns, in spite of the incompleteness of the reports, 1,119 cases of lead poisoning (lead line, or suspicious cases not included) came to the notice of the industrial supervision officers as compared with 174 in 1911, and 93 in 1910. Subsequently 564 cases were reported for 1911 and 526 for 1910, making the totals for these two years 738 and 619, respectively.

The only industrial disease which has been reportable universally throughout Germany (not only actual cases of the disease but suspected cases as well), and for the reporting of which the physician giving treatment is responsible, is anthrax. (Law in regard to the control of communicable diseases in effect June 30, 1900.) In its industrial origin it is included in the term "Accident," and it has been considered an industrial injury and has been compensable under workmen's accident insurance legislation operative since 1884. The Imperial Insurance Law of 1911 gave the imperial councillor (now Minister of Labor) the right to extend accident insurance to include certain industrial diseases. By the decree of October 12, 1917, the award of insurance and pensions to dependents in cases of fatal poisoning by aromatic nitro compounds—the chief poisons of the war industries—was allowed, and thereby a partial equality of these diseases with accidents was attained.

The introduction of obligatory reporting of industrial diseases is at present under discussion, and is being studied by the Central Government. The Institute of Industrial Hygiene at Frankfort-am-Main has published a questionnaire on the subject worked up by Francke and Bachfeld (Berlin, Julius Springer, 1921). Opinions are widely divergent; one group, especially the representatives of the workmen, seeks compulsory notification, while others—and I myself am of this group—have serious doubts as to the advisability of such a measure. We fear—and not unjustly, I believe,—that incomplete reporting of industrial diseases will lead to an undervaluation of the frequency and, consequently, of the significance of these diseases. The main difficulty, however, is that examination of the reported cases and confirmation of the diagnosis must take place, if industrial hygienic measures are to be founded on the reports; and yet this is only possible when there exists a sufficient number of authorized physicians experienced in dealing with industrial diseases, who by virtue of their training are in a position to draw conclusions as to the hygienic measures necessary, and to recommend improvements in processes or in safety devices. It is not merely a matter of industrial hygiene in its narrower sense; industrial diseases, in the opinion of many, should be compensated in the same way as industrial accidents. Out of common justice and in accordance with the principle of compensation for loss of working power due to dangerous occupations, which is the basis of accident insurance, this opinion seems to be well founded. (Compare my report to the International Workmen's Insurance Congress in Rome, 1908.) The placing of industrial diseases on a basis with accidents presupposes, however, that the diagnosis be confirmed as soon as possible, particularly in cases of acute illness, for if confirmation of the diagnosis is deferred until some later time,

[1]Francke, E.: Die gewerblichen Metallvergiftungen in Preussen nach dem Jahresbericht der Gewerbeaufsicht für 1912. Zentralbl. f. Gewerbehyg., 1913, *1*, 392.

the facts of the case can rarely be established. In order to make the early confirmation of the diagnosis possible, therefore, a large staff of physicians trained in industrial diseases is necessary.

Although many suppose that compulsory reporting of industrial diseases will pave the way for equal treatment of diseases and accidents before the law, I am of the opposite opinion. It is only legal equality that will be sufficient reason for compulsory reporting. Who will be interested in carrying out the notification if no one derives any immediate profit? The employer will always find notification a hardship on account of the possible change in his manufacturing system which may result from it; the workman will not be interested because it may often cause him to be temporarily inconvenienced through exclusion from his work; to the physician it is only a nuisance. If, then, there is no one who has any interest in the preparation of the report, it will not infrequently be neglected. It is different when the workman knows that a legal claim can be founded on the notification; then he will take care that the notification is carried out. As I have already stated, however, there must be on hand an experienced physician who can immediately confirm the diagnosis.

I have explained that inspection of factories in Prussia, and in almost all other parts of Germany as well, has until recently been exclusively in the hands of engineers. The number of physicians active in factory inspection in Germany is very small. Württemberg, in 1905, and Alsace-Lorraine, in 1906, assigned to a health officer in the public employ the duty of hygienic adviser to the industrial supervision office. In 1906 Baden had a physician, Dr. Holtzmann, who was factory inspector in charge of the common factory inspection and who, in addition, filled the position of medical adviser to the factory inspection service. In 1912 he was appointed Chief Official Industrial Physician. In 1909 Bavaria appointed Dr. F. Koelsch state industrial physician and his sphere of activity has extended throughout the whole country and over all factories subject to the Industrial Supervision Office. He is expert adviser of the government and the supervision office; he co-operates in the enforcement of workmen's protection laws by revision of industrial processes, and by organization and supervision of the examining physicians. Further belonging to his duties are investigations in industrial hygiene in preparation for new laws and regulations, scientific work, examination of groups of workers and laboratory work. In the thirteen years of his activity in science and in practice, he has accomplished a vast amount. In spite of the excellent results obtained in Bavaria, not until 1920 did another German state, Saxony, appoint a state industrial physician, Dr. Thiele. Recently, however, Prussia has come to the fore by naming five state industrial physicians whose authority and whose duties will be similar to those of the Bavarian state industrial physician. As the first of these, I began my work four months ago.

If industrial diseases are to be really understood and, through an understanding of them, a basis for their prevention established; if compulsory reporting is to be carried out in a satisfactory manner; and if an identical handling of industrial diseases and accidents is to be brought about, then development of medical co-operation in the field of industrial hygiene and of industrial supervision must be extended

in at least two directions for which the foundations already mentioned exist in Germany: (1) increase in the number and the independence of examining physicians, to whose care is entrusted the supervision of the health of workers in the various hazardous industries; and (2) increase in the number of physicians employed in actual industrial supervision. This is the preliminary step toward all further progress in this field, and it seems now as if this progress would be made possible in the near future.

INDUSTRIAL DISEASES OF FUR CUTTERS AND HATTERS*

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MERCURIALISM

THE descriptions of industrial mercurialism as found in the textbooks cannot be applied to the disease as seen in hatters without some modification, for these descriptions are based on studies of trades in which the exposure to mercury is greater and the form of poisoning more intense and rapid. Such trades are mercury mining, backing mirrors with mercury, fire gilding, and manufacturing mercurial compounds. The hatter is exposed for many years to very small quantities of mercury, and the form of intoxication produced, except in very bad shops, is slow to develop and lacking in some of the more striking manifestations of typical chronic mercurialism.

Symptoms

Mouth.—According to Tylecote (1), the most characteristic findings in the mercurialism of hatters are in the mouth, although in a typical case there is little or no salivation. Six out of eight of Taylor's (2) cases had no salivation, and Monti (3) thinks that dryness of the mouth is usual, with perhaps an occasional attack of salivation. Telcky (4) says that mercurialism in hatters is characterized by tremor without salivation. Glibert (5) also believes that an excessive secretion of saliva is unusual in this form of industrial mercurialism. All of the five severe cases described by Adler (6) had profuse salivation, but it is rare to find so rapidly developing and extreme a form of intoxication in this trade as was shown by his cases.

The odor of the breath is said to be recognizable by the expert and is usually described as metallic, but in serious cases it may be fetid. Often the gums are spongy, redder than normal, and bleeding easily. The tongue is described by Tylecote as large, dove-colored or silvery, flabby, and showing indentations from the teeth. Sommerbrodt (7) says that an early sign is the appearance of localized white spots on the mucosa surrounded by bluish or reddened areas, "pharyngeal hydrargyrosis." Various descriptions are given of the mercurial line which is occasionally observed along the margin of the teeth. According to Monti, it simulates quite closely the Burtonian lead line but is more brownish; Adler calls it bluish; Glibert, a dirty red —rarely blue; and Tylecote describes it, not as granular, but as an almost uniform purplish line along the swollen margin of the gums. Glibert has never seen it in carrotters, only in workers who handle carrotted fur. Among 468 workers he saw a typical Burtonian line with bluish patches on the mucosa of the cheeks in fifty-seven or 12.1 per cent.

The teeth are often blackened, especially the upper and lower incisors of carrotters exposed to the acid fumes. Sizers show this effect on the teeth also, but not so frequently. Glibert says that the women in the Belgian fur cutting trade brush their teeth more than the men do and they suffer more from in-

*Received for publication March 2, 1922.

flamed gums than do the men, although their teeth are much less black. The enamel of the teeth is eroded and decay follows. As pyorrhea sets in with retraction of the gums, the teeth loosen and fall, the upper molars going first (8). The older workers in Italian and French and Czecho-Slovak factories are practically toothless, according to my observations, and, from their own account, the loss of their teeth was quite painless. Monti had a case of necrosis of the right lower maxillary bone, necessitating operation.

Tremor.—Teleky, Monti, Taylor, Harris (9), and most of the French writers consider the presence of tremors as the most characteristic sign of mercurialism in hatters, while Tylecote thinks the characteristic signs are to be found in the mouth; Glibert finds tremors and mouth lesions present with practically the same frequency. In Taylor's cases, the course of the disease was slow and insidious, and the first symptom noted by the workers was tremor. The characteristics of mercurial tremor are as follows: It is a fine trembling of the muscles which, according to Teleky, is typically interrupted every few minutes by coarse, shaking movements. When the hands are stretched out, with fingers spread, the tremor is seen distinctly, then diminishes as the man becomes accustomed to the position, and may die away for a minute, only to start up again. Tylecote says the fineness of the tremor has been overstated; it is coarser than that of exophthalmic goiter or of alcoholism. Taylor's tracings showed eight per second. It is not so regular as that of alcoholism or of paralysis agitans, and another distinction between the latter and mercurial tremor, according to Erben (10), is that in mercurial tremor it is the whole hand which trembles, while in paralysis agitans each finger has its own movement. The tremor begins usually in the fingers but in the early stages can often be seen in the eyelids when the eyes are closed, in the lips when they are drawn back to expose the teeth, and in the protruded tongue. It is an intention tremor, increasing as efforts are made to control it and increasing with precision of movement. For instance, if a glass of water is put into the outstretched hand, the tremor increases; and it becomes even greater if an attempt is made to carry the glass to the mouth. It tends to die down during rest—in this respect it differs from senile palsy—and even in extreme cases it stops during sleep. There are no sensory symptoms accompanying it, although there may be some numbness and profuse sweating of the palms.

As the case progresses, the tremor passes to the arms and then to the legs, which may jerk and jump, especially when they are swung forward in walking. In one of Adler's cases, the feet knocked against each other as the man walked. Going up and down stairs becomes especially difficult; a boy seen by the investigators for the Civic Federation (11) could get downstairs only by sitting down and lowering his body from step to step. It is very difficult to walk a narrow path and, in several instances described to me, a workman who was still capable of carrying on his trade, the motions of which had become almost automatic, could not reach his workbench alone but had to be guided by a fellow-workman along the narrow aisle between the whirling belts of the machinery. There is a famous case of "hatters' shakes" in Orange, N. J., a man who kept on at work long after he had developed severe tremors. He could not feed himself nor dress himself, and the only way that he could get to work

was by pushing before him a baby carriage which served to steady his gait. When he reached the plant he would be guided to his bench, and then he was able to carry on the work familiar to him through years of practice.

In severe cases, the tremor is generalized. The five men seen by Adler had involvement of all the muscles, except those of chewing and swallowing, and Gilman Thompson (12) saw a case of generalized tremor in a hatter, as severe as paralysis agitans. Speech is affected, becoming hesitating or stuttering and thick but not staccato. The handwriting may be like that in paralysis agitans. The knee jerk is usually overactive, but there is no ankle clonus. Stiffness of the muscles and difficult flexion of the elbow have been described. According to Glibert, Letulle found a loss of strength, especially of the flexors of the arms and the fingers, but Glibert was not able to confirm this, although he found an indication of weakness of the extensors. Teleky saw two cases of radial palsy. The tremor usually passes away if the patient can be induced to give up his work before it has reached a serious stage, but in any hatting center there are histories told of men who had the "shakes" for years after quitting the shop. Teleky saw one case in which the tremors had lasted fifteen years, and another in which they had lasted thirty years. A man in Danbury had typical tremors for thirty years.

Tylecote calls attention to the possibility of an acute attack in the course of chronic poisoning in an old worker; as, for instance, a hatter, twenty-five years in the trade, who had a typical acute intoxication with salivation, diarrhea, and bloody stools. It was not till after he had recovered from this that his tremors began. Tylecote has also seen an apparent immunity break down if a man returns to work too soon after some weakening illness.

Psychic Symptoms.—Kussmaul's *erythismus mercurialis* (psychic irritability of a high grade) is not marked in the mercurial poisoning of hatters. Teleky says that psychic changes are rare, and that there is, at the most, only lassitude and weariness. Tylecote finds "nervousness" common, and he and others describe loss of memory, dullness of the intellect, drowsiness by day and insomnia at night, lack of self-control and poise, easily aroused anger, and causeless embarrassment. The most marked instances of psychic disturbance in the literature of mercurialism among hatters are to be found in the Civic Federation's (11) report of the industry in New York City and vicinity. In fourteen of the eighty cases studied, there are noted such symptoms as insomnia, depression, and melancholia, sometimes with suicidal tendency.

Gastro-Intestinal Tract.—No characteristic symptoms are found here, perhaps because in this industry the mercury does not enter the body through ingestion, but through the respiratory tract, and excretion seems to take place chiefly through the lower intestine. Tylecote says that diarrhea is unusual, and Adler did not find it once in his five severe cases. Constipation is much more common. Taylor saw no signs of gastro-intestinal irritation, but Schoull (13) found gastric disturbances among French hatters and a curious change in appetite, a distaste for nitrogenous food and a craving for vegetables, spicy foods, and acids. Monti says that Italian hatters acquire a distaste for red wine.

Skin.—Carrotters may suffer from the effect of nitric acid on the skin, and sizers, who in some factories are required to add the dye to the sizing kettle, complain of inflammation of the

fingers, especially around the nails. A true mercurial dermatitis, such as may occur after mercurial inunctions, is rare. Schoull says that carrotters often suffer from obstinate dermatoses; Gilman Thompson has seen several cases of eczema in hatters; Schütte (14) makes a general statement as to eczema being common in the industry, but Teleky has seen no industrial exanthem in hatters, and Tylecote says that, although cracks and fissures may be caused by the acid added to the hot water, he has never seen erythema or papular eruptions.

Urine and Blood.—There is a difference of opinion with regard to urinary findings. Monti finds polyuria; Tylecote says that scanty urine, sometimes with quite normal constituents, occurs too often to be accidental. Both say that albuminuria is rare, mercury having not nearly so damaging an effect on the kidney or on the blood vessels as lead. Monti says that the kidney may eliminate mercury for a long period without albumin appearing in the urine. On the other hand, both Teleky and Harris found albuminuria in a large number of cases. Mercury has been isolated from the urine of hatters by Monti, but Taylor could not find it in either urine or feces.

There is nothing characteristic in the blood. The red cells are likely to be diminished moderately and there is a slightly greater loss of hemoglobin, but stippled cells are not found. The differential count of whites shows an increase of lymphocytes at the expense of the polymorphonuclears, so that sometimes the relation between the two is actually reversed, but, according to Agasse-Lafont and Heim (15), this sign appears too late to help in the diagnosis, rather it is of grave prognosis. There is nothing to distinguish the blood of early mercurial poisoning from that of other metallic poisonings and, if any striking changes are found, they indicate profound impregnation with mercury.

Prevalence of Mercurialism in Hatters

The quantity of mercury to which hatters' furriers and hat makers are exposed is, as we have seen, slight, yet this industry is looked upon by Europeans as one of the worst of the poisonous trades, calling for strict regulation and, according to many writers, for the total prohibition of acid nitrate of mercury as a felting agent. (See Chaplet (16).)

France.—It is in French literature especially that one finds gloomy pictures of the men and women in the fur cutting trade, and many efforts have been made in France to introduce a non-mercurial carrotting fluid. The discussion begins with Hillairet's (17) paper, read before the Academy of Medicine in 1869, on the evils of mercurialism among hatters, although prior to that time several men had tried to find a substitute for mercury, the first effort being apparently the use of sulphuric acid by Guichardière in 1817 (16). From 1869 on, the subject has never been dropped except for a temporary suspension during the war. In 1892, Jungfleisch (18) brought the matter again before the Academy of Medicine, saying "We all know the terrible accidents to which are exposed the workers in this industry . . . mercurial poisoning continues to decimate the fur cutters." In 1907, Espanet (19) spoke before the third Congress of the *Association Ouvrière pour l'Hygiène des Travailleurs* on the dangers of this trade, and, as a result, the Congress petitioned the Department of Labor to take measures for the suppression of the use of mercury. Since all that fol-

lowed was a law prescribing certain precautions in fur-cutting plants, Martial (20), in 1911, being profoundly impressed with the dangers inherent in mercurial carrot, revived the agitation against its use. Martial had investigated fur-cutting shops and had found a great deal of mercurialism. There were in 1911, he says, from 500 to 600 members of the hatters' syndicate in Paris. Two hundred and fifty of these were hatters' furriers, and 60 per cent. of them he found to be affected with mercurialism. The mortality from mercurialism was 2 to 3 per cent. per year. Martial himself examined forty-nine persons working at the time and found evidence of mercurial poisoning in twenty, although this was during the slack season when only the best workers were left. All carrotters, he believes, acquire mercurialism within five years' time, and, of the others, about 30 per cent. are poisoned in five to fifteen years, 10 per cent. after fifteen years. He says: "Nobody of course thinks of denying the shocking (*néfastes*) effects of the acid nitrate of mercury. Everyone knows it is a poison and recognizes the damage it causes."

The French law of 1898 is very detailed. It forbids the employment of anyone under 18 years of age in carrotting or in plucking or cutting, if there is much dust. The employment of women is likewise prohibited. The law requires floors to be of impermeable material, clean and in good condition, and the walls also. The carrotting fluid must be made only at night and in a separate room. Exhausts must carry off the vapors from the drying rooms, and the rooms in which skins are stored, carrotted, blown, and cut must be abundantly ventilated. Carrotters must wear gloves of rubber or heavy leather, and for all who handle the skins after carrotting the employer must furnish a suit of washable working clothes. Wash basins and soap must be provided and a separate lunch room; no food may be kept or eaten in a workroom. A doctor must examine once in three months all workers who come in contact with carrotted fur and, if signs of mercurialism are detected, the worker must be shifted to work which will not expose him further. Yet the French sanitarians regard these safeguards as inadequate, and they are leading a movement to prohibit the use of mercury in felt hat manufacture, just as they led the movement against the use of white phosphorus in the match industry, and the use of white lead in paint.

I was in France in the summer of 1921 and was permitted to visit fur-cutting shops in Vincennes. One feature of the French method is distinctly dangerous and suggests one reason why the trade has so bad a reputation in that country. Drying the carrotted skins is accomplished in rooms heated by a brazier of burning coke or charcoal, which may raise the temperature to 112° F. (44.4° C.), or even to 165° F. (74° C.). The skins are carried in and hung for a couple of hours or overnight, according to the kind of carrot desired, and then the workers go in and carry them out again. Inasmuch as the greater part of the mercury is said to pass off during the drying process, the danger of this method is obvious, and the French government has recently forbidden its use, but has allowed time for compliance with the new law. In one of these French plants, I saw an old woman working on raw skins right beside the open door of the drying room.

Belgium.—There are two descriptions of the making of felt hats as carried on in Belgium, both by Glibert (5) who has long been connected with the Depart-

ment of Labor of Belgium. The first was given before the International Congress of Hygiene in Brussels in 1903, the second before the same congress held in Washington in 1912.

The industry in Belgium has a very bad reputation. It is, in part, a home industry, poorly paid, and carried on by the very lowest class of the community. There is one step in the preparation of skins for carrotting which can be done by hand better than by machinery, but it is only in Belgium that workmen can be found to do, on a large scale, this hand work, which consists in plucking out the long stiff hairs so as to leave only the fine fur behind. It is impossible to do this as well by machine; Belgium is, consequently, the source of hand-plucked skins for the rest of the world.

The various processes in the preparation of hatters' fur in Belgium are chiefly in the hands of women, except for carrotting, which is always done by men. Glibert found that the average length of employment for the men was nine years and four months, and for women, seven years and five months. He made a careful comparison of the health records of women in the fur cutting trade and of women in textile work in the linen mills, and found that there was little difference between them. On the other hand, the men carrotters have a high sickness rate and 66.67 per cent. of those examined by him showed symptoms of mercurialism — namely, tremor in 61.9 per cent., stomatitis in 11.12 per cent., and anemia in 9.5 per cent. Examination of women employed in the processes which expose them to contact with mercury — brushing, cutting, and blowing the carrotted fur—gave these results:

Occupation	Mercurialism %	Tremor %	Stomatitis %	Anemia %
Brushers	47.46	28.80	27.12	5.08
Cutters	43.60	25.55	24.23	3.52
Blowers	44.58	32.53	31.33	7.23

Among the blowers who did not show symptoms at the time, 20.34 per cent. gave a history of symptoms in the past. The men suffered more from tremor, probably because of alcoholism, which was frequent among them but rare among the women. The presence of these symptoms did not always mean loss of health; in fact, 57.49 per cent. of those with signs of mercurialism were in good general health. The condition of the factory had a decided influence on the amount of industrial poisoning. For instance, a comparison between a good, a medium, and a bad factory gave the following results: average amount of poisoning in a good factory, 37.21 per cent.; in a medium factory, 56.25 per cent.; in a bad factory, 88.89 per cent.

The following table gives the percentage of cases of mercurialism in men and women according to the length of employment:

Length of Exposure Years	Women with Mercurialism %	Men with Mercurialism %
Up to 5	34.48	54.26
Up to 10	46.84	52.00
Up to 20	60.71	66.67
Up to 30	57.14	100.00
Up to 35	100.00	66.00

At the International Congress of Hygiene in Washington in 1912, Glibert presented another report, not so complete, the gist of which can be given in the following table:

Occupation	Sex	No.	Health Good	Health Mediocre	Health Bad
Before carrotting	men	705	91.91	7.80	0.28
	women	938	84.21	15.68	0.11
Carrotting	men	88	63.64	31.82	4.54
After carrotting	men	44	77.37	22.72	—
	women	435	68.96	28.96	9.00

Great Britain.—At the Brussels Congress of 1903, the felt hat industry of Great Britain was described by T. M. Legge, Chief Medical Inspector of Factories and Workshops. The occurrence of mercurialism among hatters had been brought to the attention of the govern-

ment toward the end of the last century by the appearance of several cases of marked poisoning among women. An investigation was ordered and a detailed report was submitted by three women inspectors, Miss Deane, Miss Squire, and Miss Patterson in 1898 (21). Pronounced cases of mercurialism were not found to be numerous but serious outbreaks did occur occasionally. From the description by these authors it is plain that the usual method of drying the skins in British factories at that time was on racks in heated rooms, and, while in some factories the racks could be drawn out, in others the skins were carried out by hand. The cutting departments were said to be very dusty, and in one there had been an outbreak of mercurialism among the women. "Locking"—*i.e.*, sorting out the inferior pieces from freshly cut fur—was said to be bad. The women lockers had to protect their wedding rings against the action of the mercury. In passing, I may say that I have never been able to find the wedding ring of a sorter in an American factory showing any such effect.

Legge visited these same factories in 1900 and examined some of the workers. Among twenty-one women who had worked from one to seventeen years, he found only a single case of mercurial tremors, but in another factory nine out of seventeen had tremors. This last group had all worked at least ten years. Carrotters suffer more from nitric acid fumes, others from mercurialism, as this table (8) shows:

	No. Examined	Bad Teeth	Tremors
		%	%
Carrotters	30	66.6	3.3
Other processes..	81	33.3	21.0

Mercurial poisoning was brought under the law requiring notification of cases in May, 1899, and by December, 1918, 208 cases had been reported. However, only forty-six of these came from the hatters' trade, twenty-seven from the hatters' furriers, and nineteen from the hatters. Forty-six in almost twenty years does not indicate any great danger of mercurialism in the British hat industry. According to Porter (22), writing in 1902, there is very little mercurialism in the making of hats as distinguished from fur cutting. Stockport is the center of hat making, not fur cutting, and in this city observations carried on by Porter show that dust, especially that produced by pouncing (smoothing the hat with sandpaper), is the worst evil, mercurialism being negligible. Stockport hatters, according to Porter, have a tuberculosis rate 63 per cent. in excess of the average. On the other hand, Tylecote (1) of Manchester, another large hat center, presented a paper before the International Congress for Hygiene at the meeting in Washington in 1912. He said that, while mercurialism among hatters' furriers had long been a matter of common knowledge, it had been recognized among hat makers only to a slight extent, and the cases notified had come almost entirely from among furriers. His attention was called to mercurialism in hat makers by a case of what he had at first supposed to be disseminated sclerosis in a "stover," a man employed in heating shaped hats at 180° F. Analyses made for him by W. M. Gardner of Bradford showed the presence of 0.138 per cent. of mercury in the finished hat. After this Tylecote saw twenty more cases of mercurialism in hatters, all men, as no women are employed in these plants. Two were in youths. Fur blowers inhale mercury-laden dust; plankers —sizers, as we call them—soaking and working felt, are exposed to moist heat which is favorable to the absorption of

mercury through the skin, the respiratory tract, and the digestive tract. Taylor (2) found that a piece of fur from the cutting machine contained 1.34 per cent. of mercury.

Germany.—The felt hat industry has not been as fully studied in Germany as in most countries. Indeed, it seems to have attracted less attention than any other industry involving the use of a poisonous substance. There is a section devoted to it in Weyl's Handbuch der Arbeiterkrankheiten, by P. Schütte (14) of Magdeburg, but the information given is general in character, and the greater part is devoted to the effect of fur dust on the respiratory tract, not to mercurialism. Dust is said to be the great danger—a danger increased by mercury. The only other German article which I have found on mercurialism in the felt hat industry is a paper read by Heucke (23) before the Washington Congress of Hygiene in 1912. He gives no statistics as to the health of hatters' furriers or of hat makers, but says positively that these are dangerous trades and that the safeguards are inadequate. According to his description, the skins are often hung on racks and pushed for drying into heated rooms where burning coke furnishes the heat, and the carbon monoxide vapors, as well as those of mercury, are allowed to escape into nearby rooms. He speaks of the danger of nitrous fumes, especially in preparing the carrotting fluid, and says that all workers, from carrotters to the packers of finished hats, are exposed to mercury and that cases of poisoning occur, not only in fur cutting, but also in hat making. He found in hatters' fur only a small percentage of mercury, 0.3 to 0.7 per cent., but in sweepings and dust as much as 1.3 per cent.

Austria.—Teleky (4) of Vienna described the slow chronic form of poisoning found in hatters, as contrasted with the more rapid form which develops in other mercury-using industries where the exposure is more intense. It is evident from his description that the trade is not nearly so harmful in Austria as in some other countries. He examined the workers in two large factories. The first, an excellent place, employed 2,400 men and women, and there he found twelve persons with symptoms of mercurialism while four others were at the time incapacitated from the same cause, making one in 150 employed. The second factory was distinctly less well managed and there, among 500 to 600 employed, he found seven at work with symptoms of poisoning, or about one in eighty. The larger of these factories, Hückel's Söhne of Neutitschein, I had the opportunity of visiting in the summer of 1921, and found it admirable in construction and in management. Teleky's analysis of blown fur showed the presence of 2.338 per cent. of mercury

Italy.—In Italy, the centers of the hat industry are in the north and, although there are many cities in which such work is done, mercurialism is not at all notorious; in fact, little is known about it. Monti (3) investigated the industry and published his findings in 1909. He complains that in order to convince the manufacturers of the reality of this danger he was obliged to demonstrate the presence of mercury in the urine of some of the workers. He examined twelve carrotters, only three of whom were free from all lesions, even of the teeth. Seven of the twelve, employed from three to eight years, had bad teeth and complained of dyspepsia and of dryness of the mouth, with occasional attacks of salivation. The eleventh was much emaciated and the twelfth showed marked emaciation and typical tremor. He also found two out of five hardeners

with typical chronic poisoning of pronounced degree and three of slighter degree. Fifty sizers were also examined; thirty-five had marked mercurialism, nine a slight form, and only six were negative.

This is apparently the only report on mercurialism in hatters in Italian literature, and the subject is not even mentioned in Pieraccini's textbook. The trade is not notoriously unhealthful in Italy, partly, perhaps, because much of the fur cutting for Italian manufacture is done in Belgium, partly because conditions in the larger plants, at least, are excellent. The famous Borsalino factory in Alessandria, employing about 2,000 persons, and Valera and Ricci's in Monza, employing 1,200, are striking instances of what can be done to render work in this industry, not only safe, but comfortable, as I had an opportunity to see in the summer of 1921. There are certain features in the Borsalino factory which are superior to anything I have seen in this industry in any country.

Russia.—In 1909, Levitsky (24), a Russian, wrote an article for the *Revue d'hygiène* of Paris, describing a mission upon which he was sent by the Moscow Zemstvo to inquire into conditions in the felt hat industry in other European countries and to obtain suggestions, if possible, for a non-poisonous substitute for mercurial carrot, which the Russians were convinced was the source of much industrial poisoning. Levitsky gives no facts as to the industry in Russia prior to his journey, which was made in 1902, but says that the Zemstvo wished to discover a radical remedy for the terrible industrial disease of hatters—mercurial poisoning. "The question of suppressing the use of mercury in this industry is a question of delivering several hundred thousands of men and women from the suffering caused by chronic mercurialism, from invalidism, and premature death." Levitsky took back specimens of fur carrotted by the Jourde-Lussigny formula (sodium hydroxide and potassium hydroxide, followed by nitric acid and carbon), and the Zemstvo of Moscow induced one of the co-operative factories to work it up into felt. This was done with such success that two more factories undertook to carrot by this method altogether, the Zemstvo guaranteeing them against loss for four years. The hat makers of St. Petersburg, Moscow, and Warsaw declared the felt satisfactory and other co-operatives adopted the no-mercury process, so that in 1909 Levitsky was able to write that sixty-seven plants, employing 1,500 workers, were using the non-mercurial formula, and he was hopeful that mercurial carrot would be altogether done away with in Russian factories.

United States.—The first mention of the manufacture of felt hats in the United States was in 1662, when the Virginia Assembly offered a reward of 10 pounds of tobacco for every good felt hat produced from the fur of native animals. The importation of felt, of hatters' fur, and of finished hats has always been carried on very extensively, but for the last few decades the United States has also exported these hats. The industry falls into three divisions in the United States: fur cutting, "making," and finishing. Sometimes a plant that cuts fur also "makes" the hat, and the so-called hat factory may simply finish the bodies supplied by the "make shops." Other factories, but a minority, carry on all the processes from the raw skin to the finished hat. Philadelphia, Orange, Newark, New York City, Brooklyn, Yonkers, and Danbury and Bethel, Conn., are the principal hat manufacturing cities.

The earliest study of mercurial poisoning in the making of hats was made

by J. Addison Freeman, M.D. (25), of Orange, N. J., and was published in the *Transactions of the Medical Society of New Jersey* for 1859. This author reports that during the winter of 1858-1859 and the following spring there prevailed among the hatters of that region a disease showing all the characteristics of mercurial poisoning, swelling and ulceration of the gums, loosening of the teeth, fetid breath, abnormal flow of saliva, and shaking palsy of the upper limbs. More than a hundred cases occurred in Orange alone.

The next report is twenty years later, from the same city, Orange. In 1878, L. Dennis, M.D. (26), published a paper in the *Annual Report of the New Jersey Board of Health* on "Hatting as Affecting the Health of Operatives." The report is admirably complete and deserves far more attention than it has ever received. Conditions in the industry at that time seem to have been very bad, partly because of the use of very strongly carrotted shoddy. In some instances "all hands in the shop within a few days were rendered unfit for work or had their health impaired." Dennis gives the records of 1,546 men, with an average age of 32 years and average employment of twelve years. One hundred and two had a history of tremor in the past; fourteen had tremor at the time. Fifty-six had a history of sore mouth; twenty had it at the time. The incidence of these symptoms was highest in hardeners, next in finishers. Out of 168 cases of mercurialism which could be traced to their source in the factory, 107, or 63 per cent., were in finishing, and among 438 finishers then at work, eighty had mercurialism. Dennis insists that the finishing benches should be furnished with exhausts, as are the pouncing benches but there are obviously practical difficulties in the way. Among 39 blowers, 74 coners and wetters, and 39 hardeners he found respectively 8, 14, and 25 cases of sore mouth and tremor. Curiously enough, only two out of 450 cases of mercurialism were in sizers.

Much less valuable are two short papers, written in 1887 for the Board of Health of Connecticut by A. L. Scott and S. W. Williston. The different processes in the industry are described, but a very optimistic view is held by Scott as to the unhealthfulness of the trade; indeed, he refuses to believe that mercurial poisoning really occurs in Danbury, and holds that the cases thus diagnosed should be attributed to malaria. Williston says that there is quite a little mercurial poisoning, especially in forming, and that soft felt hats are worse than hard felt hats because they need much more finishing with pressing irons, and therefore more mercury is volatilized.

Philadelphia has long been one of the important centers for the manufacture of hats, including the preparation of the fur. The only report from that city that I have been able to discover is one written by L. H. Adler (6) in 1891. He describes five cases of severe mercurialism in hatters and, judging from their histories, the exposure to mercury must have been much greater then than it is at present, for it is very unusual to find so short an exposure resulting in such severe lesions. A boy of 14 was poisoned after a year's employment sweeping and feeding fur into cutting machines, but his loss of health began as early as the second month of his employment. A young man of 19 years, at the end of two and a half years' employment (which means that he began work at 16½ years), was obliged to give up because of ataxia and jerking movements like those of major chorea. His gait was unsteady, his hands shaking, his tongue

tremulous, gums sore and swollen, breath fetid, and his memory impaired. The three others were men of 36 to 63 years of age and had worked only eight, nine, and ten years. When Adler saw them, they were suffering from salivation and gingivitis and palsies so severe as to incapacitate them. Number 3 was 35 years old, had been a hatter for ten years, had lost flesh from year to year and suffered from frequent attacks of indigestion and constipation. At the end of eight years tremors began, in the hands at first, then spreading all over the body and accompanied by muscular twitchings but no impairment of sensation. The tongue was affected and his speech was hardly intelligible; he had much difficulty in going down stairs, and suffered from terrifying dreams. After quitting work for several months and taking salt baths, he was somewhat improved but remained ataxic and tremulous, with marked blurring of the vision, tremors of the tongue, thick speech, fetid breath, spongy gums and loosened teeth.

In 1911, the New York Labor Department in its annual report included a section on the felt hat industry in New York State, written by C. T. Graham-Rogers and Charles Vogt (27). Apparently, at that time there were various harmful features in the industry which are not found now in well-constructed modern factories, such as exposure to the dust from cutting machines which had no exhaust, and to dust from pouncing. Many boys and girls were said to be employed. In one shop, 2.6 mg. of mercury were found in 1 cubic meter of air.

A very interesting study of mercurial poisoning was made by Mrs. Linden Bates (11) for the Women's Welfare Department of the National Civic Federation and issued by them in monograph form in 1912. This report comprises an analysis of 102 cases of industrial mercurialism occurring in New York City and its vicinity. Most of these cases had had their origin in the felt hat industry of Brooklyn, Yonkers, Newark, and Orange. Mrs. Bates had already made an investigation of the same industry in Great Britain. It was not possible for the investigators to study the physical condition of the men and women actually at work but they were able to discover a number of cases of mercurial poisoning which had come under the care of physicians, chiefly in hospitals and clinics. Their conclusions are made conservatively and no cases listed without the diagnosis of a physician. They found that mercurial poisoning was notorious, especially, so it was said, among the men using imported skins which were already carrotted. Whatever the reason, it was universally believed that foreign carrotted pelts were much worse than those prepared in this country. In plants doing their own carrotting, the solution was made by mixing four carboys of nitric acid, 75 pounds of mercury and 50 of water. Sometimes a mixture of silver nitrate, corrosive sublimate, and arsenious acid was added to this.

Carrotting was generally held to cause acid fume poisoning but not mercurialism. However, the investigators found a carrotter in the hospital who had been under treatment for six months for mercurialism. He had been obliged to stop work on account of sickness seven times in fourteen years, and at the time was suffering from anemia and tremors of the limbs so severe that he could not stand. Drying did not seem to be attended with as much trouble in American factories as in the British. Brushing was usually fairly well carried on, but cutting and sorting were quite

bad. Eight cutters were found suffering from chronic poisoning, seven of them with blackened and eroded teeth and marked tremor which, in the case of three, incapacitated them for work. There was also found to be a good deal of trouble among formers and hardeners and sizers. Of thirty-one cases of chronic mercurialism studied, thirteen came from forming, five from hardening, and thirteen from sizing.

In all, eighty cases of chronic mercurial poisoning were found, and their histories are given as much in detail as possible. With regard to twenty-one, only the diagnosis could be obtained, but the histories of the other fifty-nine show that tremors were present in forty and localized paralysis in four, multiple neuritis in five. In fourteen there were psychic disturbances, insomnia, headache, depression, even melancholia, impaired memory, hallucinations, and, in five cases, suicidal tendency. It is interesting to note that salivation is mentioned only once.

As many of these men were the wreckage of the industry, it is to be expected that their condition would sometimes be very serious but none of the foreign studies of mercurialism in this trade give so extreme a picture of physical degeneration as do this report and the one of Adler's already quoted.

Finally, there is an investigation made by Louis I. Harris, M.D. (9), Chief of the Division of Industrial Hygiene of the New York City Health Department, which covers the hatters' fur industry and the manufacture of felt hats in that city. Dr. Harris examined 266 persons engaged in the preparation of hatters' fur, 110 of them being women. They were for the most part Italians and Poles of a poor social grade, and, according to their own statement, fifty-one of the women and 118 of the men drank alcohol regularly. Only seventeen of the whole number were found to be free from physical defects. Dr. Harris endeavors to be very cautious as to the amount of mercurialism present, but he found ninety-one cases of either very marked or moderate tremor of the arms, face, and tongue. He also found eighty-three with marked inflammatory or spongy condition of the gums. Seventy of the seventy-seven carrotters and cutters had black teeth, and seventeen had signs of advanced arteriosclerosis. He succeeded in obtaining thirty-three specimens of urine for examination, and sixteen were positive for albumin.

The evidence of mercurialism among hat makers was less striking than among hatters' furriers. Only eighty-one persons could be examined, all but twelve of them men. Seven had marked tremor, seven more moderate, and eleven slight. Harris does not accept these last as clear cases of mercurialism. Anemia was present in twelve of the sixty-nine men, and marked gingivitis in three.

His summing up of the two industries together is as follows: Among nearly 350 employees, forty-seven, or nearly 14 per cent., had distinct gingivitis, together with marked or violent tremors of the hands, face, and tongue; another 14 per cent. had moderate tremor with gingivitis, accompanied in a number of instances by anemia and arteriosclerosis.

The rate of poisoning, especially among the furriers, is very high compared with that reported in recent years from Great Britain, and compared with the rates found by Teleky in a similar study in Austria.

Prevalence of Other Occupational Diseases among Hatters

Loss of weight, pallor and loss of strength are, according to some observ-

ers, almost universal among hatters. Thus Schütte describes the women in this industry in Germany as thin, narrow-chested, stoop-shouldered, with pale, emaciated faces, dull eyes, shallow breathing, complaining of headache, general weakness, frequent nosebleed, and menstrual disturbances. Several French writers, Espanet, Jungfleisch, and Martial, speak of the industry as extraordinarily unhealthful, causing many deaths each year. Schoull says that hatters suffer from profound anemia, and Levitsky believes that invalidism and premature death are common among Russian hatters. On the other hand, Glibert finds that women in the Belgian fur cutting trade do not compare unfavorably with those employed in other low-wage industries, such as the linen mill operatives. There seems to be a general impression that women fur cutters and hatters suffer from scanty menstruation and are more likely to abort than are the majority of working women, and that the mortality rate among their children is higher. But Glibert found that in this respect the linen mill operatives were rather worse off than the women hatters, at least so far as the death rate of their children is concerned.

It is, however, with regard to the prevalence of respiratory disease that the greatest difference of opinion is found. The most sweeping statement as to the injury done to the respiratory tract by fur dust quite irrespective of the mercury is made by Schütte, who calls this the most harmful feature of the hatters' environment. He describes the various "dust inhalation diseases from animal dust" as: nasal catarrh, not of the usual kind but purulent and offensive; ozena, caused by putrefaction of the hair dust in the nostrils and followed by atrophic rhinitis; catarrh of the throat from the mouth breathing, necessitated by the clogged nostrils; chronic laryngeal catarrh, often purulent, and followed by erosions and ulcers of the vocal cords; chronic bronchial catarrh with emphysema. It is also assumed by the French that fur dust is in itself injurious, although they believe that by far the greater danger faced by the hatters is mercurialism. Among the English, Taylor thinks phthisis is frequently the cause of death in hatters, mercurialism rarely; while Tylecote says that there is not sufficient ground for the belief that the prevalence of phthisis is higher than the average in this trade except among blowers and finishers. In those groups which show the greatest incidence of mercurialism —formers, plankers (sizers), pressers, and stovers (dryers) — he saw no increase of respiratory disease.

The only real attempt to differentiate between the effect of mercury-free dust and carrotted dust was made by Glibert in the Belgian factories. The work of preparing the skins for carrotting is largely a home industry in Belgium. It is very filthy work and to the ordinary visitor it seems to be most unhealthful. The raw skins, with bits of flesh and dried blood and all sorts of dirt adhering to them, must be cut open by hand and trimmed, and then the coarse hairs plucked out and the skins brushed. At the Brussels Exposition, in 1910, I saw some faithful reproductions of peasant huts and tenements in which this process of *éjarrage* was being carried on, and certainly it was a disgusting sight, offensive to eyes and nose. Glibert, who has been familiar with this trade since 1892, assures us, however, that it is filthy but not unhealthful. He superintended a thorough physical examination of the workers made by the state physicians, who could find little more than a

slight irritation of the nasal mucosa, sometimes conjunctivitis, sometimes otitis externa, but no occupational disease. He believes that the long, flexible hairs do not reach the lungs but are caught in the upper air passages and expectorated. His statistics show that among the men working with non-carrotted fur 91.9 per cent. were in good health, but only 77.3 per cent. of those working with carrotted fur and 63.6 per cent. of the carrotters.

In 1886 J. W. Stickler, M.D. (28), of Orange, N. J., published a paper on "Hatters' Consumption." His studies were made in hat factories, not fur-cutting plants. He found that those engaged in the felting processes and in pouncing suffered commonly not only from tremor but from catarrh and rheumatism and pulmonary disease. Fifty-three per cent. of the deaths among hatters in the Newark-Orange district from 1873 to 1886 were from pulmonary phthisis. He collected 772 records of deaths among hatters in the Orange valley, in Connecticut, and in Philadelphia, 375 of whom, or 51.8 per cent. had died of phthisis. The other occupational diseases, tremor, rheumatism, and catarrh, were found distributed as follows:

Occupation	Catarrh	Rheumatism	Cough	Tremor or History of Tremor
240 sizers	76 (31.6%)	44 (18%)	41 (17%)	30 (12.5%)
27 pouncers	12 (44.4%)		4 (15%)	5 (18.5%)
222 finishers[1]	64 (28.8%)	15 (6.7%)	42 (18.9%)	33 (14.8%)

[1] There were also 18 with sore mouth or history of sore mouth; 7 with bronchitis; 4 with phthisis; and 1 with asthma.

Stickler says that mixers and blowers suffer chiefly from catarrh and rheumatism, that coners, hardeners, and blockers add tremor to these two; sizers have these same and also pulmonary affections; pouncers suffer from pulmonary affections and tremor, finishers from all of the above affections.

The investigators for the National Civic Federation found in the hatting centers of northeastern New Jersey a general consensus of opinion as to the prevalence of tuberculosis, especially among the finishers and pouncers. Selskar Gunn, Health Officer of Newark, in 1908 wrote of "the extreme prevalence of tuberculosis among hatters." In an effort to decide the degree of health hazard to which hatters are exposed, Frederick Hoffman, Statistician for the Prudential Life Insurance Company, compared the mortality in this trade with that in the tailoring trade which is accepted by insurance companies at ordinary rates, although there are injurious features connected with it, such as sedentary indoor work. He finds that hatters have a higher mortality than tailors at all ages, but especially in the thirty years between 35 and 65, during which period the excess is 4.1 for the first decennium, 7.2 for the second, and 23.4 for the third. The following statistics were presented by this company at the International Congress for Tuberculosis in Washington, 1908, demonstrating the proportion of deaths from tuberculosis to deaths from all causes between 1897 and 1906:

	Percentage of Deaths from Tuberculosis among	
Ages	All Males in United States	832 Hatters
15-24	27.8	53.8
25-34	31.3	55.4
35-44	23.6	45.4
45-54	15.0	26.7
55-64	8.1	14.8
65 and over	2.7	0.8

How hopeless it is to look for accurate information on this point in the vital statistics of American cities is shown in the figures collected by Hoffman. In 1886 to 1890, the proportion of deaths from tuberculosis to deaths from all causes amounted among Philadelphia hatters to only 25.3 per cent., but among

Brooklyn hatters to 39.1. In 1890 among the hatters of Connecticut, only 29.1 per cent. of the deaths were caused by tuberculosis, but among those of New Jersey 37.3 per cent. were due to this cause. In Danbury I was assured by the men in the industry that a search through the vital statistics of that city would be useless trouble, for it was well known that, if a man died of tuberculosis within a few years of taking out insurance, the family insisted on having the death certificate made out for some other disease in order to avoid difficulties with the insurance companies. Nevertheless, the figures from Danbury, when compared with those from cities in Connecticut of about the same size, and with those from the whole state of Connecticut, do show a higher mortality rate and a higher proportion of deaths from tuberculosis. The following statement has just been secured from the Connecticut Department of Health for the year 1921.

	Population	Death Rate per 1,000 Population	Death Rate from Tuberculosis per 1,000
Danbury	22,325	15.2	1.21
Greenwich ..	22,997	11.5	0.61
Torrington ..	22,860	8.0	0.48
Whole state	1,420,576	11.4	0.96

John T. Black, M.D., Commissioner of Health, writes that the town nearest in size to Danbury is Middletown, but that the State Hospital for the Insane is located there and therefore the data for this town are not comparable with those for Danbury. Greenwich, situated at sea level, has, as its principal industries, agriculture and the manufacture of woolens, tinners' hardware, iron and belting. Torrington, in a hilly district, is a manufacturing city, the principal industries being the manufacture of sheet and rolled brass, copper and spelter castings, nickel, silver and gold plated goods, needles, machines, upholstery, and woolen goods. One would expect to find the rate of tuberculosis in Torrington at least as high as in Danbury.

Summary

Industrial mercurialism as seen in hatters is slow in onset and course, and lacks some of the characteristics of more rapidly developing forms of this intoxication. Salivation is rare, but gingivitis is fairly common, especially at the beginning. Carrotters suffer more than others from blackening and erosion of the teeth. Tremor is the most typical symptom; erethism is not common; and there are no characteristic findings in the gastro-intestinal tract, the skin, the urine or the blood.

Statistical data from the different countries of Europe show a much higher rate of mercurialism among fur cutters and hatters in Belgium, France and Italy than in England and Austria. Recent studies made in New York City and northeastern New Jersey revealed a great deal of mercurialism in these trades and many instances of the severer forms, especially in fur-cutting shops.

The emery dust produced in finishing (pouncing) is excessively fine silicious dust, and constitutes an occupational hazard that is beyond dispute, but the question of the harmfulness of the animal dust produced in various departments of fur cutting and hat making is in a state of great confusion and cannot be settled without a much more thorough examination of the men and women employed in these processes than has been made so far.

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